SYSTEMS ENGINEERING AND OPHTHALMOLOGIC TELEMEDICINE: PREVENTING BLINDNESS

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GOALS

• Understand eye disease and telemedicine principles
• Understand eye care at the VA and eye care delivery methods
• Understand how systems engineering can help prevent blindness
LEARNING OBJECTIVES

• Discuss eye disease, telemedicine, and teleophthalmology
• Discuss Technology-based Eye Care Services (TECS) program
• Discuss impact and eye care delivery with TECS
• Discuss systems engineering principles and how they apply to TECS
VISION IS...

• Critically important to quality of life
• Keeps people independent and healthy
• High priority for patients
Why did Mr. C not get his eye care sooner?
What barriers are there?
FACTS

• Eye disease is more common as people age

• People over age 65 should have an eye exam every 1-2 years.

• As people age, less likely to seek out eye care

WHY?
Older people are more likely to:

1. Live in rural places and be medically underserved.
2. Be dependent on others for transportation.
3. Limited income and cannot afford cost to travel.
4. Doctor visit fatigue.
TEST!

• What is the leading cause of curable blindness in the world?

• What is the leading cause of incurable blindness?

• What is the leading cause of blindness in working age adults?
FACTS

Top 4 most prevalent eye diseases:

1. Cataract
2. Glaucoma
3. Macular Degeneration
4. Diabetic Retinopathy
EYE DISEASE IN THE VA

1. Veteran population older than general population
2. Also higher rates of minorities
3. Higher percentage of diabetics
1. Medically underserved have no close private providers, especially ophthalmology
2. Significant cost to the system in care coordination

CLINIC VISIT MODEL
1. Rapid growth far exceeding growth capacity
2. Patient barriers: far drive, travel cost

VA Optometry

OR

VA Ophthalmology

OR

Community Care
TELEMEDICINE PRINCIPLES

Defined as care delivered where the patient and the provider are separated by distance.

Two major types:

1. Synchronous/Video – direct visual connection between provider and patient
2. Asynchronous/Store & Forward – gather data in one place at one time, store data, reviewed by provider in a different place at a different time
EXAMPLES OF TELEMEDICINE IN MEDICINE

- Tele Primary Care
- Tele Dermatology
- Tele Psychiatry
- Tele Rheumatology
- Tele Geriatrics
- Tele ICU
- Tele Rehabilitation

- On the patient end, there is a “presenter” that facilitates the patient encounter. In many of these programs providers use video to actively manage or view the exam results
- Consultative services
- Store and Forward (e.g. dermatology)
WHAT IS TECS?

Use technology to provide routine or follow up eye care to improve access.

Prevent blindness
TECS

Ophthalmology Technician works full time at primary care clinic – COLLECTS INFO

Detailed history

Eye Pressure/CCT

Vision/Eyeglasses

MD interprets

EHR Note

Checkpoints/Protocols /Peer Review

ALL done in a 10X12 room
TECS SET UP
WORK SMARTER
EYE CARE DELIVERY AS A SPECTRUM OF NEEDS

VA has limited resources
Goal is to devote most expensive and time consuming care to the patients who really need it.

- Basic: Screening and Eyeglasses
- Intermediate: Early disease, more testing
- Advanced: Subspecialty care, complex disease, surgery
Eye Care as a Spectrum of Needs

Increase outsourcing to telemedicine methods of basic Eye Care needs; exams and eyeglass dispensing (TECS)

Reduce outsourcing of ophthalmic surgery and subspecialty care consults; keep in system

Optometry and Comprehensive Ophthalmology

M CENTER FOR HEALTHCARE ENGINEERING & PATIENT SAFETY
WHAT DOES THIS HAVE TO DO WITH SYSTEMS ENGINEERING?
TOOLS IN THE TOOLBOX TO CARE FOR PATIENTS

• VA now has many delivery methods to take care of Veterans’ eyes.
• What tool is best in what setting?
• How should the tools be deployed?
• What factors need to be considered?
• Is TECS cost-effective/cost-neutral?
WHAT KIND OF ENGINEERING PROBLEM IS THIS?

Combinatorial matching problem

- Deciding locations to offer eye care and how to staff those locations

Constrained resources

Multi-criteria decision

- Consider cost, distance traveled, number of patients seen, etc.
ENGINEERING PROBLEM STATEMENT

Goal: Evaluate which locations to offer eye care screenings and what providers types to staff each eye care location

Assumptions:

• Patients go to “assigned” clinic for eye care screening
• One-year time frame
• Patients have homogeneous screening need (one screening every other year)

Limitations:

• Considering eye care screening only (follow-up care not included)
• No consideration for patients’ provider preferences
BRIEF OVERVIEW OF FACILITY LOCATION

• Mixed integer programs to optimize placement of facilities to meet demand
• Objective typically to minimize cost or distance traveled
• Constraints on allowable assignments, customer demand
• Often used in production/distribution/logistics

GENERAL MODELING APPROACH

Possible eye care locations
• 25 VA locations in Georgia

Decide:
• At which locations do we offer eye care?
• What kind(s) of provider should staff each location?

“Assign” patients
• Each zip code to clinic location(s)

Consider scenarios
• Start from current state
• Start from scratch
MODEL OVERVIEW: FEASIBILITY CONSTRAINTS

• Patient Capacity
  • Number of patients assigned to clinic cannot exceed clinic capacity
    • Capacity subject to type/number of providers at each clinic

• Demand
  • Percent of patients assigned per zip code should be between a lower and upper required percent

• Provider Capacity
  • Each clinic can hold a maximum number of providers
    • Maximums exist at each clinic for providers of a given type and total number of all types of providers
MODEL OVERVIEW:

OBJECTIVE FUNCTIONS

A. Maximize total number of patients assigned
   1. Additional constraints:
      I. Budget
      II. Furthest distance allowed to travel

B. Minimize overall costs
   1. Additional constraints:
      I. Minimum total number of people screened
      II. Furthest distanced allowed to travel

C. Minimize furthest distance traveled (future)
   1. Additional constraints
      I. Budget
      II. Minimum total number of people screened
DATA OVERVIEW

• Patients accessing Georgia VA for (any) care in 2017
  • Approximately 200,000 patients considered
  • Group patients by zip code
• Clinic locations
  • 25 VA clinics in Georgia
    • 15 currently offer some type of eye care
• Driving distance from center of each zip code to each clinic location calculated via Google API
• Budget/costs, provider capacities, and other clinic-specific values obtained from VA
RESULTS: MAXIMIZE PATIENTS ASSIGNED

(max dist: 150 miles, min 5000 total screen)

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<th>From current</th>
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From scratch:
- $20 Million: 28980
- $21 Million: 45360
- $22 Million: 60480

From current:
- $20 Million: Infeasible
- $21 Million: 23928
- $22 Million: 40980

Budget:
- 0%
- 5%
- 10%
# RESULTS: MINIMIZE COST

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**From current**

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(min 5000 total screen)
NEXT STEPS

Model minimizing maximum distance traveled objective

Incorporate stochasticity
  • Consider patients not visiting their “assigned” clinic

Consider implications for follow-up care
  • How are ophthalmologist/optometrist case mixes impacted?

Generalize beyond Georgia
  • Apply to other VA regions considering TECS
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CLOSING/DISCUSSION